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AN AMERICAN LEPIDOSTROBUS

CONTRIBUTIONS FROM THE HULL BOTANICAL LABORATORY 144

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(WITH PLATES XXVIII AND XXIX AND THREE FIGURES)

The remarkable uncovering of the structure of paleozoic strobili and seeds during the last decade, chiefly from sections of English and French material, has brought to the American morphologist a feeling of disappointment that the extensive American Coal-measure deposits have yielded these structures only as impressions or casts. Extended inquiry has failed to discover such petrified material in any of the collections, so that its occurrence is evidently quite unusual.

A short time since there came into our hands, through the courtesy of Dr. STUART WELLER, of the Department of Geology of this university, a specimen of *Lepidostrobus*, the strobilus of *Lepidodendron*, that was evidently petrified. It had been collected in 1900, in a coal pocket in Warren County, Iowa; and in January 1911 came into the possession of Professor JOHN L. TILTON, of Simpson College, Indianola, Iowa, who brought it to this university, and in whose collection a portion of the sectioned cone is to be found.

The specimen is not a complete strobilus, but a fragment from near the upper end, broken at an angle above, and squarely across below. As a consequence, if the strobilus was heterosporous, all evidence of the megasporangia had disappeared with the missing lower portion. The fragment is 6 cm. long and 5 cm. in diameter at base, and all the structures proved to be very well preserved except the axis (figs. 1 and 2), which had been almost completely destroyed and replaced by calcite and pyrites. The strobilus was a mature one, which had fallen and remained in the water or moist soil, for rootlets had penetrated between the sporophylls here and there, and the rootlets in turn had been attacked by a fungus. Nearly all of the sporangia are empty, only a few spores being occasionally in place, but masses of spores occur in many places between the sporophylls.

The general structure of *Lepidostrobus* is well known, but it seemed worth while to section this American specimen and to record the results. We have not attempted to refer it to any described species, as this would involve us in unfamiliar details. The only purpose is to describe briefly the structure of the first American Coal-measure strobilus to be sectioned, so far as we can discover.

The stalks of the crowded sporophylls stand approximately at right angles to the axis of the strobilus (fig. 2), and are triangular in cross-section, the keeled abaxial face fitting between two sporangia on the sporophylls below (fig. 4). This stalklike base of the sporophyll is about 20 mm. long, and broadens widely as it joins the lamina (fig. 5), whose plane is approximately at right angles to that of the stalk. The lamina is 20 mm. long, extending below the plane of the stalk in a broad triangular base and narrowing rapidly above into a long acuminate extension (fig. 8). The result is that each lamina overlaps several others above, the surface appearance of the strobilus resembling that of a roof covered with pointed tiles; and the broad, wavy, and notched base interlocks with the sporophylls below. The sporangia are thus very closely and heavily incased, and all the structures of the strobilus are fitted solidly together. A single and very simple vascular strand traverses the stalk of the sporophyll and continues into the lamina, consisting of a small central group of protoxylem elements (fig. 20), completely invested by a narrow zone of vessels of larger caliber, and this in turn by a broad zone of delicate tissue which abuts against the cortex.

In the narrow space between the distal end of the sporangium and the base of the lamina, the ligule appears as a small conical body arising from a shallow pit (fig. 16). This relationship of the ligule to the sporangium and the lamina of the sporophyll seems to be constant among the ligulate forms, the distance from the base of the sporophyll in this case being determined by the great radial extension of the sporangium. The cells of the sporophyll immediately below the pit of the ligule are much longer than the other cells, and radiate from the ligular pit. These radiating and elongated cells perhaps indicate that in the early stages of the sporophyll considerable photosynthetic work was done by the ligule.

The cells of the ligule itself are small and almost isodiametric; and its tip is invariably withered.

The most characteristic feature of *Lepidostrobus* is the radially elongated sporangium, which extends along the whole adaxial face of the stalk of the sporophyll. In our specimen the sporangium is 17 mm. long and 2.5–3 mm. broad, attached along the central axis of the stalk by a narrow connection, and bulging pouchlike beyond the sides of the stalk, until the latter broadens into winglike extensions near the lamina. Only in the distal region of the sporangium is there any evidence of a "subarchesporial pad," which appears in section as a broad and low dome of tissue (fig. 12); there is no evidence of any radiating sterile tracts within the sporangium.

The most notable feature of the sporangium, aside from its radial extension, is its dehiscence (fig. 6). A series of transverse sections indicates this very clearly (figs. 9–13), and also served as the basis of a restoration. The sporangium dehisces longitudinally along the median line for a little more than half its length from the base, and then the line of dehiscence forks and is represented in the distal half of the sporangium by two diverging lines, which leaves between them a large triangular flap of the sporangium wall. In most cases the structure of the outermost layer of sporangium wall is well preserved, consisting of the characteristic "prismatic palisade-like cells" (figs. 17 and 18). The wall, under pressure of the adjacent structures, is quite definitely angled (figs. 9 and 16), and at these angles the palisade-like cells are conspicuously elongated, and within the angles there are usually traces of the more delicate inner wall layers. No special mechanism of dehiscence was discovered, although it is reasonable to suppose that one exists in the case of this singular dichotomous or triradial dehiscence. Since the distal ends of the sporangia abut against the heavy interlocking bases of the laminae, it is altogether probable that the continuation of the median longitudinal dehiscence becomes mechanically impossible.

It is to be regretted that the basal part of the strobilus was not secured, so that the question of heterospory might have been answered. The spores observed are probably microspores, and their appearance is sufficiently indicated in fig. 19.

The fungus referred to above as accompanying rootlets that had penetrated among the sporophylls presents stages that seem worthy of record. The mycelium is abundant and wide branching, and suggests that of a phycomycete, since no cross walls are apparent except in a few cases, and these cases might be only such as appear among phycomycetes. In many instances the hyphae bear what are evidently zygotes; and such stages as that shown in fig. 21 suggest the development of a sex organ. The situation represented in figs. 22 and 23 furthermore suggests that the fungus had oogonia and antheridia. However, it is fully realized, as suggested by Dr. HASSELBRING, to whom our preparations were submitted, that such data may be insufficient to determine the fungus with definiteness; it may be an oomycete; or it may not even be

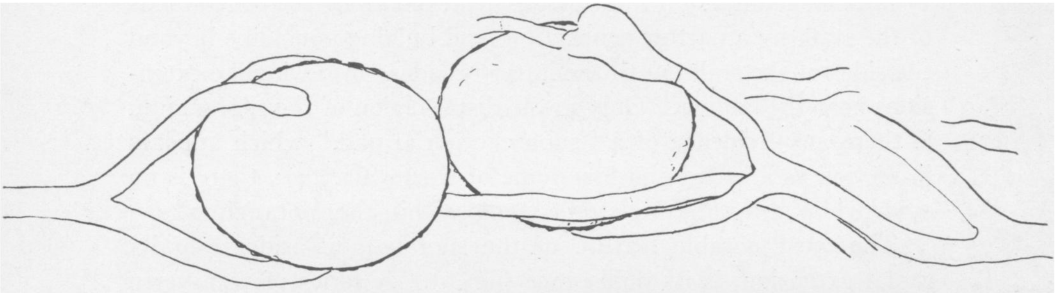


FIG. 22

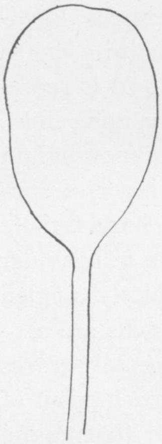


FIG. 21

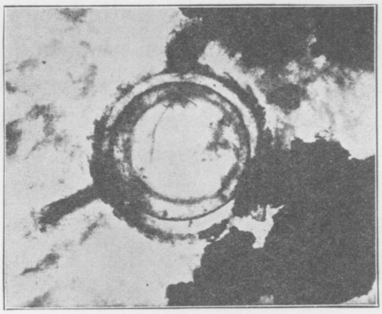
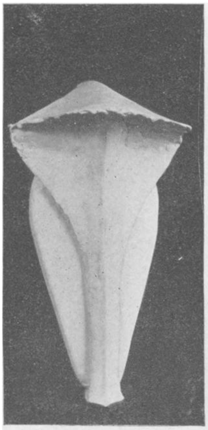


FIG. 23

FIGS. 21–23.—Fig. 21, Swollen end of hypha, suggesting a young oogonium; ×475; fig. 22, Hyphae showing two oogonia; ×475; fig. 23, Photomicrograph of fertilized egg (?) of fungus; ×141.



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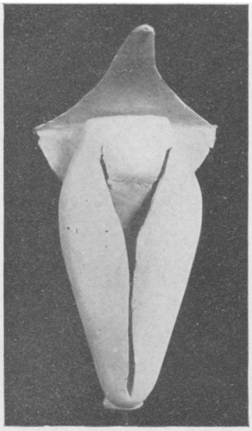

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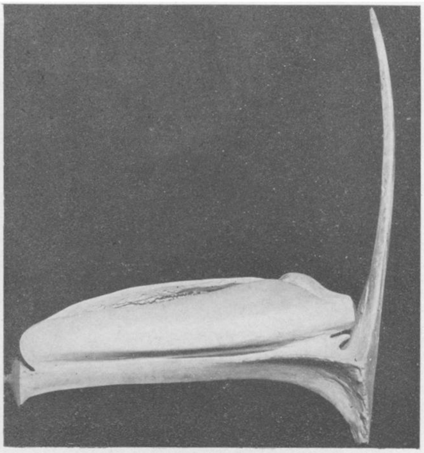

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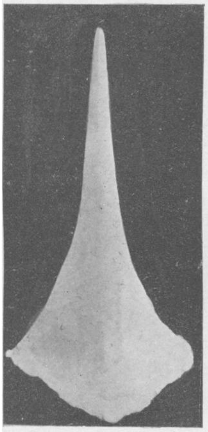

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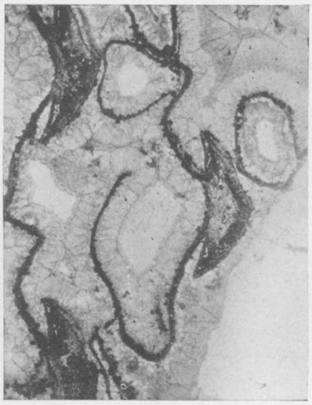

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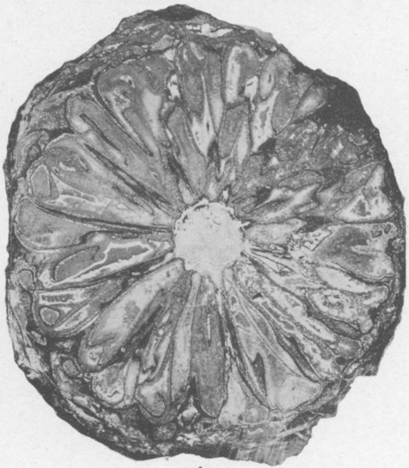

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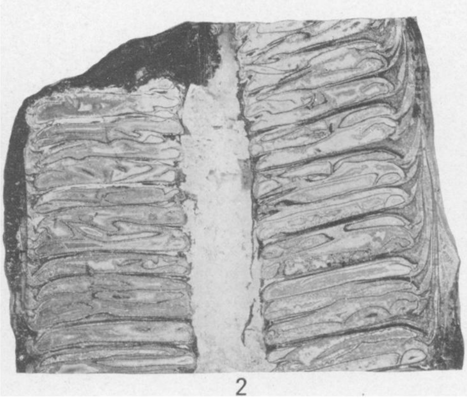

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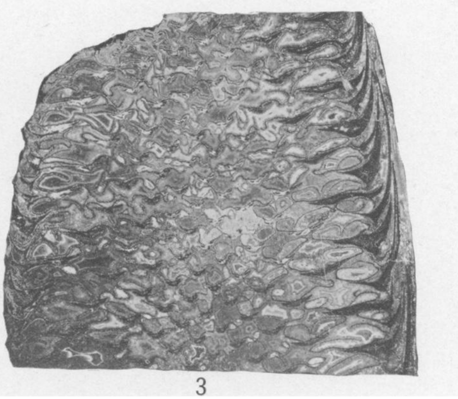

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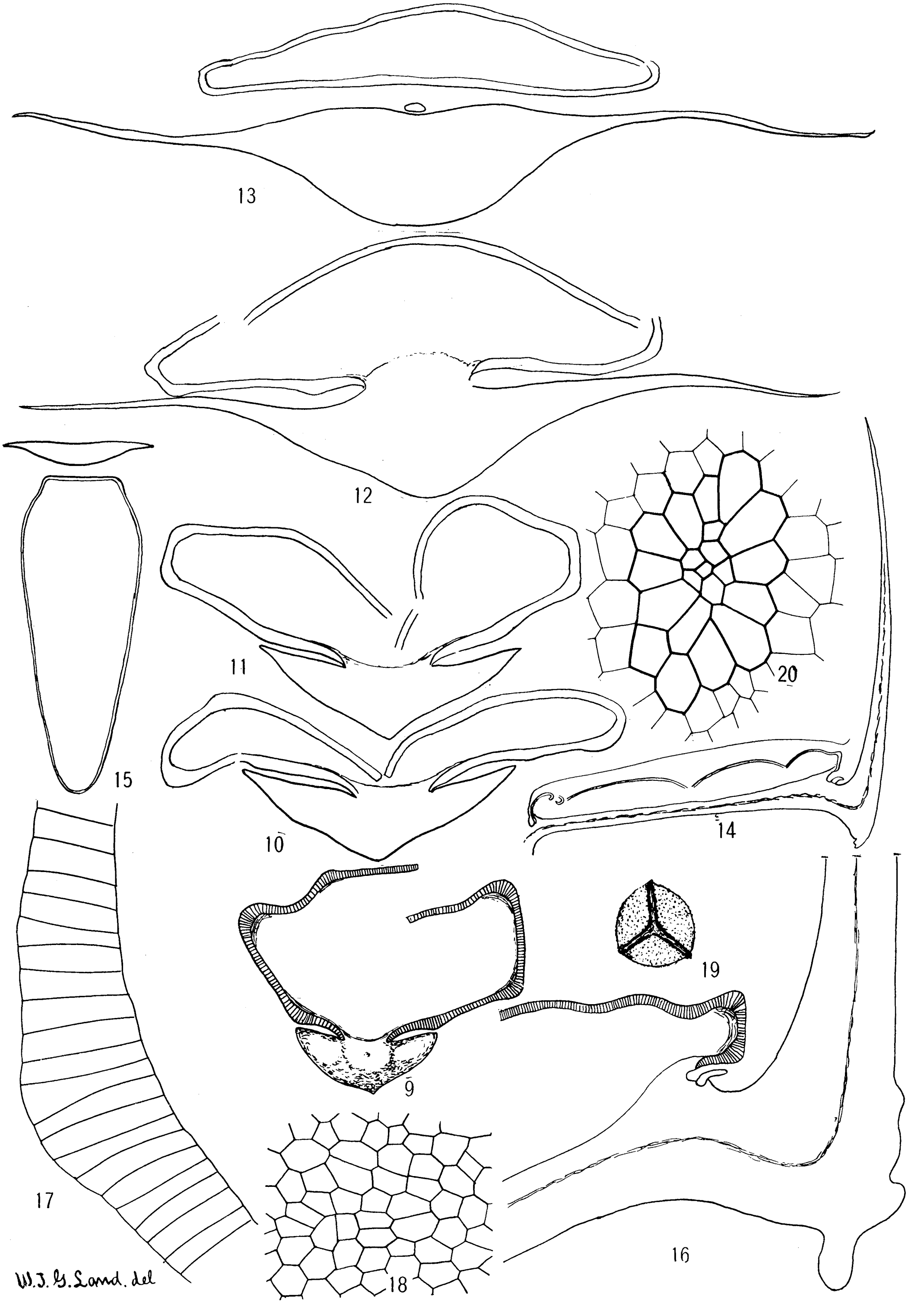
COULTER & LAND on LEPIDOSTROBUS

PLATE XXIX



COULTER & LAND on LEPIDOSTROBUS

a phycomycete; but whatever it is, it became associated with rootlets that penetrated among the sporophylls of fallen strobili of *Lepidodendron.*

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EXPLANATION OF PLATES XXVIII AND XXIX

PLATE XXVIII

FIG. 1.—Transverse section of strobilus; ×1.

FIG. 2.—Median longitudinal section of strobilus; ×1.

FIG. 3.—Tangential section of strobilus; ×1.

FIG. 4.—Transverse section of sporophyll 10 mm. from axis; ×12.5.

FIG. 5.—Abaxial view of sporophyll, from a reconstruction in plaster; ×2.5.

FIG. 6.—Abaxial view, showing dehiscence of sporangium; ×2.5.

FIG. 7.—Lateral view of sporophyll, showing relation of sporangium and ligule; ×2.5.

FIG. 8.—Abaxial view of lamina of sporophyll; ×2.5.

PLATE XXIX

FIG. 9.—Transverse section of sporophyll 1 mm. from axis; ×12.5.

FIG. 10.—Transverse section of sporophyll 6 mm. from axis; ×12.5.

FIG. 11.—Transverse section of sporophyll, showing triradiate dehiscence; ×12.5.

FIG. 12.—Transverse section of sporophyll near distal end; ×12.5.

FIG. 13.—Transverse section through sporophyll, ligule, and free distal end of sporangium; ×12.5.

FIG. 14.—Median longitudinal section through a sporophyll from basal egion of strobilus, showing ligule and path of vascular strand; ×2.25.

FIG. 15.—Median longitudinal section of sporangium parallel with the axis of the sporophyll; ×2.25.

FIG. 16.—Median longitudinal section through ligule, showing general relations of parts; ×58.

FIG. 17.—Section through sporangium wall, showing the palisade-like cells; ×229.

FIG. 18.—Section of sporangium wall parallel with its surface; ×229.

FIG. 19.—Microspore (?); ×475.

FIG. 20.—Detail of xylem of vascular bundle of stalk of sporophyll, showing central protoxylem; ×475.